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KUZEASS COMBATS UNDERGROUND FIRES

Ugol', No 9  
Moscow, Sep 1953

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Thick, steeply dipping coal seams in the Kuzbass are being worked in the Prokopyevsk-Kiselevsk area, where enormous reserves of high-grade coal of various types are concentrated. More than 74 percent of the coal in the area occurs in seams over 3.5 meters thick. Coal in these layers of the seams is inclined to spontaneous combustion, is gaseous, and is dangerous from the standpoint of coal dust.

Before 1949, thick, steeply dipping seams in the Kuzbass were worked almost exclusively with collapsing of the roof rock, and this led to considerable losses of valuable coal in the ground and to frequent underground fires. During 1951-1952, a reorganization of the mining economy in the Prokopyevsk-Kiselevsk area took place; systems of mining with coal pillars and side rock dropped to 32 percent in 1952, while the proportion of mining with backfilling rose to 18 percent. As a result of this reorganization, a slight decline in losses of coal in the mines of the region dropped from 6.6 percent in 1951 to 24.6 percent in 1952, and the number of underground fires decreased through 1951.

The number of underground fires and incidents of the area in post-war years was as follows:

|                 | 1945 | 1946 | 1947 | 1948 | 1949 | 1950 | 1951 | 1952 | 6 Months<br>of 1953 |
|-----------------|------|------|------|------|------|------|------|------|---------------------|
| Number of fires | 19   | 29   | 15   | 27   | 31   | 21   | 9    | 25   | 9                   |

The above data indicate that from 1949 through 1951 the number of fires decreased; they started to rise again in 1952, indicating a slackening in fire-prevention efforts during the past year and a half.

In addition to cases of spontaneous combustion, the spontaneous evolution of heat in coal also occurs in this area and often hinders mining operations, as is shown in the following table:

| Location of Occurrences                                  | Number of Cases of Spontaneous Heat Evolution in Coal |                  |       |
|--|---|------------------|-------|
|  | 1952  | 4 Months of 1953 | Total |
| In active mine fields                                    | 35  | 12               | 47    |
| Including those with<br>shutdown of mining<br>operations | 16  | 6                | 22    |
| In worked-out mine fields                                | 21  | 16               | 37    |
| Total  | 56  | 28               | 84    |

Thus, in 1952 and 4 months of 1953, 22 cases, or 47 percent of the total number of cases of heat evolution in active mine fields, brought about a shutdown of extraction operations. These shutdowns were no different in their results from shutdowns caused by spontaneous combustion. In both cases elimination of operations on the working front occurred, with consequent losses of coal output. In both cases a new working front had to be prepared and fire-fighting or fire-prevention measures had to be carried out.

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As is shown in the first table, 34 fires broke out during 1952 and 6 months of 1953 in mines of the Prokop'yevsk-Kiselevsk area. These fires were distributed as follows, according to working level:

| Level | Participation in Output (percent) | Number of Fires for 1952 and 6 Months of 1953 |                  |
|-------|-----------------------------------|---|------------------|
|       |                                   | Actual Number                                 | Percent of Total |
| I     | 44.3                              | 24  | 71               |
| II    | 32.8                              | 9   | 26               |
| III   | 22.7                              | --  | --               |
| IV    | 0.2                               | 1   | 3                |
| Total | 100.0                             | 34  | 100.0            |

These data indicate that about 97 percent of the fires originated in the two upper levels. This situation can be explained as follows: The upper levels were worked mainly with collapsing of the side rock and with great losses of coal, which was often located in concentrated masses. Insulation of the workings of the upper levels from the lower levels and from the surface of the mine was, in a number of cases, poor. If air seeps into the worked-out area, even in small amounts, fire can be expected to break out. Air can penetrate the worked-out area, through cracks and workings, both from the surface of the mine and from workings located below the surface. In five cases, fires started in worked-out mine fields of upper levels while extraction was in progress in lower levels, and, in 13 cases, even in the absence of extraction in the lower levels.

In all cases of mine fires, exploitative losses of coal amounted to not less than 15 percent and, usually, to more than 20 percent.

Methods of combating underground fires are: insulating the worked-out area by walling off the workings, packing silt in the worked-out area, and filling in gaps at the mine surface. Experiments have shown that packing the worked-out area with silt is a very important factor in insulating the workings. Silting operations are carried out on a large scale both for fire prevention and for extinguishing fires. Silting operations differ from backfilling in that the silt is a mud preparation designed to extinguish or discourage fires, while the backfilling material is crushed rock which may be introduced dry or by hydraulic means into the worked-out area, mainly for roof control.

In recent years about one million cubic meters of silt a year have been let down into the worked-out area of the Kuzbass. Of this, 70-75 percent is used for fire prevention and 25-30 percent for extinguishing fires. The technology of operations in both cases is similar.

As a result of technical and organizational measures carried out to regulate silting operations in the Prokop'yevsk-Kiselevsk area in recent years, the exploitation of silt-input wells has greatly improved and productivity of the wells has increased. During 1951-1952, the volume of silt transmitted through one well rose for the area from 287 to 345 cubic meters, more than double the 1948 volume. During this same period, labor productivity for silting operations rose 55 percent, and for input-well drilling, 34 percent. At the same time, the cost of these operations decreased.

At present, individual input wells, drilled from the surface, serve for carrying out the silting of worked-out areas. Such a method was complicated, even in prewar years, when mining operations were carried on at a lesser depth than at

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present, and the depth of input wells for the region did not exceed an average of 40 meters. Since that time the depth of operations has increased and, in 1952, the average depth of one silt-input well for the region reached 70 meters, with some wells up to 200 meters deep, as indicated in the following table:

| <u>Depth of Well (meters)</u> | <u>Number of Wells (percent)</u> |
|-------------------------------|----------------------------------|
| Up to 30                      | 5                                |
| 31-50                         | 30                               |
| 51-100                        | 50                               |
| 101-150                       | 12                               |
| 151-200                       | 3                                |
| Total                         | 100                              |

As the depth of mining operations increased, a check on the silting process, carried out from the surface, became more difficult. There was decreased accuracy in reaching a specific point, and conditions were created for irregular silting of the worked-out area. In drilling deep wells, it became necessary, in a number of cases, to cut through worked-out and caved-in areas of upper seams, which made drilling difficult and created the possibility of an accumulation of silt in these areas.

This indicates that the method of transmitting silt to mines through individual wells frequently fails to conform to changes which have taken place in mining operations, and a transition to underground silting is required. Silting through underground pipes has already been carried out in three mines of the Prokop'yevsk-Kiselevsk area with encouraging results. Despite some difficulties, such silting operations should be extended in the near future.

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